DISTRIBUTION OF TRUE SCORES IN THE SELECTED POPULATION AFTER TWO STAGES OF SELECTION

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C O N T E N T S

APPENDICES

A C K N O W L E D G E M E N T

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C H A P T E R - I

INTRODUCTION

A person may confront a situation where out of several alternative courses of action, one is to be selected. Such a situation gives rise to a problem of decision. The intricacies of the process of decision making has given rise to a statistical theory of decision making. Even though it is of recent origin, it is closely related to the long standing problems of educationists, psychologists, clinicians, sociologists and economists. The origin of the statistical decision theory can be traced back to, Abraham Wald, some 18 years ago. It is he who extended the statistical theory of testing hypothesis to a general type of decision theory.

Our main interest is not in the decision theory as such, but in the strategies with which decisions are made. Any kind of decision making requires adequate information about the individual, or situation, about which decision is to be taken. The society of ours continually makes people confront to the problems of decision making, about which only inadequate information is available. It is for this reason, that is to provide adequate information with regard to the problem under consideration, that the modern psychological tests exists.

A problem of selection is also a problem of decision making. The decision is with regard to who is to be selected and on what basis. This needs two kinds of informa-

mation. One is what is required of the individual who is going to be selected, so as to fulfil the purpose of selection. The other is that whether a particular individual is possessing this or not, or of the 'n' number of individuals how many are possessing the required minimum of the characteristic essential. With regard to the former, i.e. information regarding what is required of the individual can be obtained by a previous analysis of the job, or work, or duties. But with regard to the latter, information gathering is difficult. As said early, it is here that, tests are to be made use of. In a problem of selection, when we speak of tests, the real interest is in any information gathering procedure including items like physical and physiological measurements, biographical enquiries, clinical tests and interviews.

The usual test theory assumes that a final decision is made on the basis of the results obtained. This is what is usually called a single stage selection strategy. This is a fit procedure of selection only in cases where, the number of individuals from whom selection is to made is small. But take a case where out of thousands of candidates, only a few hundreds are to be selected. Here the problem is a little different. In such cases, it is possible to approach decisions with regard to selections in sequential order, where at each stage of this sequence, eliminating a few who are at the lowest cadre and at each subsequent stage, administering the next treatment or test only to the remaining one. Such a selection procedure is called

sequential strategy or multistage strategy. Such a selection procedure makes the length of the testing programme adjusted to the individual on the basis of the information about him as it is received. This strategy, makes terminal decisions after the first or a next few stages, when as for others decision is made, at the end of all the different stages. Thus such a testing process distributes efforts very effitiently. But at times the cost may go high. It is here that the question of constraints come; the constraint may be cost, the level of mean, variance or time factor. Evaluation of such a procedure is sequential procedure, can be done on the basis of expected value of the trait in the selected population and it can be studied on the basis of the proportion of misclassification. It is the first criterion that is going to be considered in the present study. The strategy is a two stage one: For example consider a common selection problem say, the selection for science talent search scheme. The aim is to select the best of all the higher secondary students of India, who are having science aptitude i.e. a particular proportion of the total pupils. How to decide an amount of talent in an individual? The answer is administer a test which measures talent. But is it possible to administer a test to all the higher secondary students of India with the same test, that too every year. This difficulty brings in the need of making a preliminary selection of a larger proportion of individuals,

through a crude measure of science aptitude, say the individuals' science score in the public examination, and then selecting the required proportion from this group. In such a case, the efficiency of the decision takers can be defined in three points:

(a) the group mean is the highest possible,

(b) the variance is the minimum possible and

(c) the cost is minimum possible.

If efficiency is defined as this, and cost function is kept constant, then the efficiency of the decision made will depend on factors namely the reliability of the first test, reliability of the second test, and the first and second proportions, the product of which always remains the same as the final required proportion.

The aim of the present study is to find out the effect of these four factors namely the reliabilities of the two tests, and the final and initial proportions of selection, in a two stage selection problem, on the efficiency of the decision made. That is to arrive at a distribution of scores and variances when different reliabilities, and different proportions are used.

But the observed scores as such do not give a real picture of the individuals ability, as they are composed of two components namely the true score and the error score. And it is essential to eliminate the contribution of the error score from the observed score. This is especially important in case of problem of classification. Thus the present study aims of arriving at a distribution of true

scores, in case of a two stages selection, when the proportions at the two stages, and the reliabilities of the two tests vary through certain values.

Problems such as the selection for science talent search scheme, are numerous in education, military and industries, and even in public administration. Such a distribution will be of great help provided the final proportion required is decided and the reliabilities of the two tests are known.

CHAPTER - II

REVIEW OF THE PAST WORK

The concept of observed score and true score is commonly known. The true score of a particular individual may be some numerical value other than the one actually observed. The individual examinee might have responded differently in a different situation, or might have been examined by a more leniant or strict examiner or the testing conditions might have been more conducive to his motivation for taking the test or vice versa. All these kinds of disturbanse, are there in any kind of testing situation. However, one is not interested in each of the different observed scores that an examinee might have obtained under different conditions. But one will be really interested in that one score, which has been approximated by these scores. This one score may be known as the true score on the test.

Ordinarily the observed test scores can be used, without separating them into what must be logically, their component parts, namely, true score and error of measurement. However from a scientific point of view, the entire concern should be with the true scores, and the observed score can be only of interest in that, it leads to inferences and generalisation regarding true scores. The frequency distribution of true scores is necessary to establish the

true group norm and true dispersion about the group norm. Various attempts have been made to infer the frequency distribution of observed scores. (1) Lord (1959) derived formulae for deriving unbiased sample estimates of any raw or central moment of the frequency distribution of true scores. (2) Mathur (1964) gave an expression for the distribution of true scores under the assumptions of the Gaussion error model and non-normal distribution of observed scores.

In the above studies, the concern had been on the distribution of true scores of the entire population. Sometimes, however, the distribution of true scores in a truncated population is of interest. This truncated population may be obtained either by a single stage selection or by a bi or multistage selection. Finney (1956) conducted one such study. His study was on the distribution of true scores in the selected population, after a single stage of selection. His assumptions were that, the distribution of the observed score before selection is a normal one, and the mean of the observed score is zero. He also assumed that the error component is independent and is normally distributed with mean zero, and a given variance. The first few moments obtained by Finney are as follows:

$$x_1 (x) = \rho \omega \nu$$

$$x_2 (x) = \rho \omega^2 (1 - \rho \nu')$$

$$x_3 (x) = \rho^3 \omega^3 \nu''$$

$$x_4 (x) = - \rho^4 \omega^4 \nu'''$$

$$x_5 (x) = \rho^5 \omega^5 \nu^{IV}$$

where w is the standard deviation of observed scores in the unselected population ρ is the reliability of the test,

$$\nu = \frac{z}{P} \quad \text{where} \quad z = \frac{1}{\sqrt{2\pi}}\, e^{-\frac{1}{2}T^2}$$

$$P = \int_T^\infty \frac{1}{\sqrt{2\pi}}\, e^{-\frac{1}{2}t^2}\, dt$$

$T = \dfrac{\eta}{\omega}$, η is the point of truncation.

ν', ν'', ν''' and ν^{IV} are the differential coefficients of ν with respect to T.

Usually, the observed scores have means which are greater than zero. Finney assumed this mean equal to zero in the sense that, he shifted the origin at mean. In order to take the distribution of observed scores with certain given quantity as a mean, the origin will have to be shifted at zero and thus the mean will have to be added to the expected value estimated by the formula derived by Finney. Since variance is independent of mean his formula can be used without any change. In his study, Finney derived a general expression for estimating the first four moments of the distribution.

A similar study, but differing in certain assumption, was conducted by Curnow (1960). His study differs from that of Finney in two respects. One is that in Finney's study, the general method gives the moments as a function of P directly, whereas in the study of Curnow, the moments are needed to be applied to a range of values of η followed by interpolation, firstly to obtain the value of η for the given value of P and secondly, to evaluate the moments for that particular value of η. The moments can also be evalu-

uated by numerical integration of the expression (2.2) given by Curnow.

Second difference of Curnow's study from Finney's is that the former, instead of the assumption of normality, assumed three different kinds of population, namely rectangular distribution, gamma distribution, and χ distribution. This study has an advantage over that of Finney is that the results obtained can be expressed fairly simply in terms of well tabulated functions. Another advantage of Curnows study is that the computation is simple in comparison to Finney's general expression. The only difficulty in comparison to Finney's study, is that Curnow's expressions, can not be used in case of sequential selection, unlike that of Finney. This is because, numerical integration also suffers from the disadvantage of expressing the moments in terms of η instead of P.

However, numerical results regarding the distribution of true scores after two stages of selection are not available. It is hoped that the present work will throw some light on two stage selection procedure.

CHAPTER - III

ESTIMATION OF MEAN AND VARIANCES - AN EXTENSION OF FINNEY'S FORMULAE

It has already been discussed that under the assumption of normality of distribution of true scores in the unselected population, Finney (1956) has worked out the first few moments of the distribution of the scores in the selected population after single stage of selection. He has also worked out the first four moments under the assumption of nonnormality. In this study, with the help of these results, these formulae have been extended for estimating the first few moments of the distribution of true scores in the selected population after two stages of selection.

The first few moments obtained by Finney (1956) are as follows:

$$\kappa_1 (x) = \rho_1 \, \omega_1 \, \nu_1$$

$$\kappa_2 (x) = \rho_1 \, \omega_1 \, (1 - \rho_1 \, \nu_1')$$

$$\kappa_3 (x) = \rho_1^3 \, \omega_1^3 \, \nu_1''$$

$$\kappa_4 (x) = - \rho_1^4 \, \omega_1^4 \, \nu_1'''$$

$$\kappa_5 (x) = \rho_1^5 \, \omega_1^5 \, \nu_1^{iv}$$

where ρ_1, w_1, and ν_1 have the same meaning as defined in the previous chapter. ν_1', ν_1'', ν_1''' and ν_1^{iv} are the differentials of ν_1 with respect to T.

The above formulae have been obtained on the assumption that the mean of observed score in the unselected population is zero. But in this study no assumption has been made

regarding the mean. The same formula can be used by shifting the origin at zero instead at mean. Therefore the expected value of true scores in the selected population after one stage of selection can be estimated from the formula given below:

$$E\,(x) = x_1(x) = \mu + \rho_1 \omega_1 \nu_1$$

where μ is the mean of unselected population.

Since the variance and higher order moments are independent of mean; these can be estimated from the same formulae worked out by Finney.

Now, in order to find out the distribution of true scores in the selected population after two stages of selection, the unselected population will consist of the parameters estimated from the observed scores by above mentioned formulae. By applying Finney's results for general case where no assumption of normality has been made, the first four moments can be estimated by the following expressions:

Let X' represents the true variate in the finally selected population.

$$\begin{aligned} E\,(x') = x_1(X) + v_2 \Big(& \rho_2 + \tfrac{1}{6} c\,(3-2\rho_2)\,T_2 \\ & + \tfrac{1}{24} d\,(4-3\rho_2)\,(T_2^2-1) - \tfrac{1}{36} c^2\,(6-5\rho_2)(2T_2^2-1) \\ & + \tfrac{1}{120} e(5-4\rho_2)\,(T_2^3-3T_2) - \tfrac{1}{144} cd\,(7-6\rho_2)\,(T_2^3-3T_2) \\ & + \tfrac{1}{324} c^3\,(9-8\rho_2)\,(12T_2^3-17T_2) + \ldots\ldots\Big) \end{aligned}$$

where v_2 is the standard deviation of observed scores in the selected population after one stage of selection and is calculated by the concepts of reliability. If ρ_2 is the relia-

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bility of second test and true variance $x_2(X)$ is calculated then,

$$\rho_2 = \frac{x_2(X)}{v_2^2} \quad \text{or} \quad v_2^2 = \frac{x_2(X)}{\rho_2}$$

$$c = \frac{x_3(X)}{v_2^3}$$

$$d = \frac{x_4(X)}{v_2^4}$$

and $$e = \frac{x_5(X)}{v_2^5}$$

$$\begin{aligned}
E(x'^2) = \varkappa_2(X) + w_2^2 v_2 \Big[& \rho_2^2 T_2 + \tfrac{1}{3}c\left\{3 + 3\rho_2(T_2^2-1) - \rho_2^2(2T_2^2-1)\right\} \\
& + \tfrac{1}{12}d\left\{6T_2 + 4\rho_2(T_2^3-3T_2) - 3\rho_2^2(T_2^3-2T_2)\right\} \\
& + \tfrac{1}{36}c^2\left\{3(3T_2^3-13T_2) - 36\rho_2(T_2^3-2T_2) + 2\rho_2^2(12T_2^3-17T_2)\right\} \\
& + \tfrac{1}{60}e\left\{10(T_2^2-1) + 5\rho_2(T_2^4-6T_2^2+3) - 2\rho_2^2(2T_2^4-9T_2^2+3)\right\} \\
& + \tfrac{1}{72}cd\left\{12T_2^4 - 105T_2^2 + 57 - \rho_2(59T_2^4 - 252T_2^2 + 93) \right. \\
& \qquad \left. + 3\rho_2^2(14T_2^4 - 47T_2^2 + 13)\right\} \\
& + \tfrac{1}{324}c^3\left\{-9(12T_2^4 - 64T_2^2 + 23) + 27\rho_2(14T_2^4 - 47T_2^2 + 13) \right. \\
& \qquad \left. - \rho_2^2(252T_2^4 - 680T_2^2 + 151)\right\} \\
& + \cdots\cdots \Big]
\end{aligned}$$

$$E(x'^3) = c\,\omega_2^3 + \omega_2^3 \nu_2 \Big[3\rho_2^2 + \rho_2^3(T_2^2 - 1) + \tfrac{1}{2} c \big\{ 9\rho_2 T_2 + \rho_2^2(3T_2^3 - 11T_2) - 2\beta_2^3(T_2^3 - 2T_2) \big\}$$

$$+ \tfrac{1}{8} d \big\{ 8 + 16\rho_2(T_2^2 - 1) + \rho_2^2(4T_2^4 - 27T_2^2 + 15) - \rho_2^3(3T_2^4 - 12T_2^2 + 5) \big\}$$

$$+ \tfrac{1}{24} c^3 \big\{ 36(T_2^2 - 1) + 18\rho_2(T_2^4 - 10T_2^2 + 5) - 2\rho_2^2(24T_2^4 - 118T_2^2 + 41) + 2\rho_2^3(14T_2^4 - 47T_2^2 + 13) \big\}$$

$$+ \cdots\cdots \Big]$$

and

$$E(x'^4) = \omega_2^4(3\rho_2^2 + d) + \omega_2^2 \nu_2 \Big[6\rho_2^3 T_2 + \rho_2^4(T_2^3 - 3T_2)$$

$$+ \tfrac{1}{3} c \big\{ 30\rho_2 + 36\rho_2^2(T_2^2 - 1) + 6\rho_2^3(T_2^4 - 8T_2^2 + 4) - 2\rho_2^4(2T_2^4 - 9T_2^2 + 3) \big\}$$

$$+ \tfrac{1}{6} d \big\{ 42\rho_2 T_2 + 30\rho_2^2(T_2^3 - 3T_2) + \rho_2^3(4T_2^5 - 49T_2^3 + 78T_2) - 3\rho_2^4(T_2^5 - 7T_2^3 + 8T_2) \big\}$$

$$+ \tfrac{1}{72} c^2 \big\{ 360T_2 + 60\rho_2(9T_2^3 - 31T_2) + 108\rho_2^2(T_2^5 - 18T_2^3 + 31T_2) - 24\rho_2^3(10T_2^5 - 92T_2^3 + 107T_2) + 8\rho_2^4(16T_2^5 - 101T_2^3 + 90T_2) \big\}$$

$$+ \cdots\cdots \Big]$$

In the present study, the mean of the observed scores in the unselected population is assumed to be 40 and standard deviation 12. In actual practice, the mean and standard deviation will be calculated from the observed scores obtained by the students in a given test whose reliability is known, say ρ_1. A proportion P_1 will be selected from the total population of students. The second test, measuring the same trait which the first test measures, will be administered on the students selected on the basis of first test. The reliability of the second test is also known say ρ_2. A proportion P_2 of students from the proportion P_1 will be selected for a given value of final proportion P of the total population.

The mean, variance and higher order moments of true scores will be calculated for the selected population after one stage of selection by above mentioned formulae, with thehelp of observed scores in the first test. Similarly, the first few moments will be calculated for the selected population after two stages of selection. In this study, these moments have been calculated for different proportion combination for a given proportion ($P = P_1 P_2 = .01$) and for different reliability combinations.

Since the mean and standard deviation of observed scores in the unselected population will vary from test to test. Therefore, the results obtained are applicable only to the population whose mean and variance are 40 and 12 respectively. These results can not be generalised to all

populations. But on the basis of these results, a trend regarding the optional combination of two proportions P_1 and P_2 can be established.

C H A P T E R - IV

RESULTS AND INTERPRETATION

The expected value of the true scores in the selected population after two stages of selection is a function of two proportions P_1 and P_2 where $P_1 P_2 = P$; and the reliabilities of the two tests or two tests batteries that are administered on the students, one at each stage, in order to know the true ability of students in a particular trait. In turn, the efficiency of a selection procedure, as mentioned earlier, depends on the proportion combination. The optimal proportion combination is such that, the reliabilities being fixed, the mean of the true scores will be the highest possible, the variance of the distribution of true scores will be the lowest, and finally, cost of the procedure of selection will be minimum. The optimal proportion combination varies from tests of one particular reliability to another.

A large proportion should be selected from the population on the basis of a test whose reliability is low in comparison to the test whose reliability is high. This is just obvious because the variation in the observed scores of students selected on the basis of a test of low reliability will be large and this large variance in turn increases the possibilities of larger misclassification. An individual of lower ability than the specified minimal ability may

cross the limit of truncation due to this larger error variance, and thus be selected, whereas, another student with an ability higher than the minimal one, may be discarded due to low score obtained in the test, due to the same reason, namely, low test reliability. This will in turn affect the expected value as well as the variance of the true scores in the finally selected population, in that the former will tend to decrease and the latter increase.

As described in the previous chapter of the study, the mean was assumed to be 40 and standard deviation 10. Final proportion P was fixed to be 1 %. Hypothetically, the value of P_1 proportion of the first stage selection, and hence P_2 proportion of the second stage selection (because $P_1 \times P_2 = P$), and the reliability co-efficients of the two tests namely ρ_1 and ρ_2 were changed; and the expected value of true scores and variance were calculated. About 72 different combination of P_1, ρ_1 and ρ_2 were taken into account.

The appendi~~ces 1 and~~ 2 represents the expected values and variances of the true scores in the selected population after a two stage selection, where, selection is made through tests of a particular reliability. A close examination of the tables reveal certain clear cut trends. Firstly the trend is that, that there are different proportion combinations for the combinations of tests of different reliabilities. If the reliability of the first test is very low say 0.6, a large proportion of individuals is to be selected

in the first stage. But since the efficacy of the selection procedure depends also upon the reliability of the second test, if its is also low, say 0.6 then it does not matter much, which are the two different proportionsof selection as far as the expected value and the variance of the true scores is concerned. But if a test of higher reliability is available for administration on the individuals, for the second stage selection, then it will be worthwhile to keep in mind what proportion is to be selected at the first stage of selection, so that the final selection will be most effective.

Generally, on the basis of the table, it can be said that if the reliability of the first test is fixed, the expected value of true scores at different proportion combinations increases, as the reliability of the second test increases. At the same time, the variance of the same decreases.

Within a reliability combination itself, the variance and mean of the true scores of the selected population ability on a particular trait varies from a particular proportion combination to another. For example for the reliability combination .5 and .6, the expected values of true scores when the proportion of first stage selection is .5, .4, .2, .1, .05 and .02, are 61.7982, 61.8187, 61.7906, 61.5400, 60.98400 and 59.8062 respectively. For this reliability combination, the highest mean is for proportion combination .4 to first stage and .025 in the second stage.

But this position will not be the same for each of the reliability combinations.

The table directly gives data about the mean and variance at different proportion combinations, for different test reliability combinations. It also indirectly gives the indication of cost trend also. As the initial selection proportion increases, the cost of administration the test also increases. For example in the first stage selecting 2% and then rejecting 1% of total population by second stage selection is less costly than, selecting 50% in the first stage, and then rejecting 49% of total population in the second stage.

By taking into consideration all the three factors namely higher mean, smaller variance and least cost, it is seen that there is one and only one optional proportion combination for a particular reliability combination. For example, take the reliability combination .5 and .9 (1st and 2nd test respectively). There the proportion combination .4 (1st stage) and .025 (2nd stage) has the maximum mean value. But its variance is not the least, and also cost is higher. But the next proportion combination, in which mean is highest is .2 (1st stage) and .05 (2nd stage). Here the variance is the lest of all, and cost is less. So this is the only combination which is the most suitable one for that particular reliability combination. Table 1 shows the most desirable proportion combinations for the different

TABLE-1

Most desirable proportion combination
for the different reliability combinations.

P_1 \ P_2	.6	.7	.8	.9
.5	(.10,.10)	(.10,.10)	(.20,.05)	(.20, .05)
.6	(.05,.20)	(.10,.10)	(.10, .[illegible])	(.20,.05)
.9	(.02, .5)	(.02, .5)	(.05, .20)	(.05, .20)

reliability combinations, similarly, there are least desirable proportion combinations. For example, for the same reliability combination .5 and .9 mentioned above, the proportion combination .02 (1st stage) and .5 (2nd stage) has the minimum mean value and maximum variance. Though, the cost will be least for this proportion combination, yet it would not be appropriate to take such proportion combination at the cost of higher mean value and low variance. Because by increasing the cost a little more, the proportion combination .05 (1st stage) and .20 (2nd stage) will give higher mean value and low variance in comparison to that of minimal proportion combination. Table 2 gives the least desirable proportion combination for the different reliability combinations.

TABLE -2.
Least desirable proportion combination
for the different reliability combination.

P_1 \ P_2	.6	.7	.8	.9
.5	(.50,.02)	(.02, .5)	(.02, .5)	(.02, .5)
.6	(.50, .02)	(.50,.02)	(.02,.5)	(.02, .5)
.9	(.50, .02)	(.50, .02)	(.50, .02)	(.50, .02)

Finally, let me put a word of caution. There may be two conditions of selection. One may be that there are only two specified test with specific reliabilities for 1st and 2nd stage selection respectively. In such a case, it is better to use the most desirable proportion combination for that particular reliability combination. The second situation may be that there is a variety of tests with different reliabilities. In such a case select the two tests which have the highest reliabilities, and select the best suited proportion combination. The efficiency will be the highest.

C H A P T E R - V

SUMMARY

As the title indicates, the study aims at arriving at the distribution of true scores in the selected population after a selection through two stages. The efficiency of this kind of selection depends upon four factors namely reliability of the first test, reliability of the second test, P_1 first stage selection proportion and P_2 second stage selection proportion, such that $P_1 \times P_2 = P$, the final proportion { Here the term efficiency comprises three factors namely mean, variance and cost. The efficiency of a particular selection procedure is said to be high when the mean is high, variance is small and cost is less. }

The main aim of the study is to find which proportion combination for a particular reliability combination will give the maximum efficient selection.

PROCEDURE

Arbitrarily, a situation was considered where the observed mean ability of the non-selected population is 40, and standard deviation is 12. The final proportion of selection was fixed to be 1%. Certain reliability combinations were selected arbitrarily.

(I test: .5 , .6 and .8

II test: .6, .7, .8 and .9)

Keeping the initial proportion as one of the six namely .6,

.4, .2, .1, .05 and .02, the mean and variance of true scores at each combination were found out. For finding out this distribution, the formulae developed by Finney for one stage selection were extended to a two stage selection problem was extended by the researcher himself.

CONCLUSIONS

1. A large proportion should be selected from the population on the basis of a test whose reliability is low, in comparison to the test whose reliability is high. Consequently the cost will be high in the former case.

2. Mean and variance of the true scores in the selected population change for one reliability combination to another. As reliability increases, the mean value of true scores in the finally selected population increases.

3. Within one reliability combination, the mean and variance changes from one initial proportion to another.

4. The cost increases as the first proportion increases.

5. By taking into consideration all the three factors namely mean, variance and cost simultaneously one and only one combination of proportions will be desirable to be used, when the reliabilities are fixed.

Finally, when a large number of test with different reliabilities are available, it is better to select the test of high reliability.

SUGGESTIONS FOR FURTHER STUDY

This study is not much comprehensive. The same

can be conducted with different initial population means, and variances, and reliability co-efficients and it can be seen whether there is any specific trend of change in size of mean and variance related to change in proportions, irrespective of the population means and variances.

It can also be extended to a situation of three stage selection and the results may be compared.

Finally, empirical validation of the findings may be done.

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TABLE SHOWING THE MEANS AND VARIANCES FOR DIFFERENT PROPORTION COMBINATIONS FOR A GIVEN RELIABILITY COMBINATIONS

	P_2	.6		.7	
	P_1	MEANS	VARIANCE	MEAN	VARIANCE
$\rho_1 = .5$	.50	58.3578	26.4780	59.9284	21.2268
	.40	59.0297	25.6262	60.0546	20.7202
	.20	59.4047	23.6625	60.2768	19.4222
	.10	59.5565	22.8710	60.2782	19.0998
	.05	59.3940	22.9433	59.9530	19.6218
	.02	58.4278	25.3879	58.7414	22.4639
$\rho_1 = .6$	.50	60.9080	30.6440	62.0264	24.6725
	.40	61.1109	29.3747	62.1782	22.7974
	.20	61.6159	26.4192	62.5068	21.7606
	.10	61.9815	24.7659	62.6610	20.7871
	.05	61.9821	24.2452	62.5467	20.7979
	.02	61.2417	26.0720	61.6561	22.2681
$\rho_1 = .9$	.50	66.6417	39.3156	67.7652	31.2294
	.40	66.9486	37.0485	67.9784	29.7475
	.20	67.6427	31.5108	68.4665	25.6277
	.10	68.1230	27.4103	68.8415	23.0948
	.05	68.6795	24.0774	69.1795	20.9677
	.02	69.1279	20.9844	69.4941	16.7202

	ρ_2 / P_1	.8		.9	
		[illegible]	[illegible]	[illegible]	[illegible]
ρ_1 = .5	.50	60.9111	16.4412	61.7932	11.6998
	.40	60.9786	21.2268	61.8187	11.8188
	.20	61.0664	18.3265	61.7935	11.2628
	.10	60.9280	15.4241	61.8400	11.7174
	.05	60.4685	16.3404	61.9509	12.0630
	.02	95.0322	20.2538	59.3062	17.6826
ρ_1 = .6	.50	63.0434	18.9864	63.9455	11.8995
	.40	65.1310		63.9820	14.3969
	.20	63.3112	17.2136	64.0420	12.8087
	.10	63.3812	16.7125	63.9410	12.8961
	.05	63.0685	17.3699	62.5546	13.9295
	.02	61.3815	25.6741	62.2172	18.3259
ρ_1 = .9	.50	68.7395	23.6959	69.6821	17.9426
	.40	68.2515		69.6985	
	.20	68.8594	23.6774	69.7817	16.4020
	.10	69.4069	19.0619	69.8970	15.8034
	.05	69.6070	17.9682	69.9993	15.0614
	.02	69.6586		69.8818	16.0021